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ABSTRACT

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PSYCHOLINGUISTIC EVIDENCE FOR A HIERARCHY OF SYLLABLE STRUCTURE

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PSYCHOLINGUISTIC EVIDENCE FOR A HIERARCHY OF SYLLABLE STRUCTURE[1]

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An experiment was conducted to investigate the linguistic concept of a hierarchy of syllable structures. Ss were asked to identify different types of consonant clusters in initial, medial, and final positions in words. Little psycholinguistic evidence was discovered to support the hierarchical ordering described in the linguistic literature. However, the results of this experiment must be classified as tentative rather than definitive.

Linguistic Basis

We are concerned with the notion of a hierarchy for syllable structure. It has been maintained in linguistics that the consonant-vowel-consonant-vowel (hereafter referred to as CVCV) syllable structure is the most basic in language. Various facts have been deduced in support of this claim: 1) Almost all languages have this particular syllable structure as one of the permitted ones; 2) The CVCV syllable pattern is the first one to emerge in child language; and 3) Various phonological processes found in language lead to the CVCV pattern. To be sure, the CVCV pattern is not the only one found in language. In English, for example, a word such as 'banana' examplifies this pattern. On the other hand, a word such as 'street' does not, since it begins with three consonants. Further, the claim is that a greater number of consonants in a cluster leads to a more elaborate syllable structure. Hence, CCV is more complex than CV but less complex than CCCV. The position of the cluster within the structure of words is also of significance. The literature suggests that initial position in the word (the consonants preceding the vowel) is more basic than final position (consonants following the vowel). The intent of the experiment is to test for the hierarchies, that is for cluster size and position of cluster.

Method

Subjects: Thirty undergraduates at the University of Michigan served as Ss. All were native speakers of English and had no history of a hearing

disorder or speech impediment. Ss were paid for their services.

Materials: Twenty-four artificial words conforming to English phonotactic constraints were constructed as target words. The 24 target words consisted of two versions of 12 different syllable structures. The 12 syllable structures had 3, 2, 1, and 0 consonants appearing in three positions: word initial, word medial, and word final. Thereafter two variants of each target word were constructed. These 48 variants differed in syllable structure from their targets by the addition or deletion of consonants in the original cluster (see Appendix A for data). For example, if one of the original target items was 'spláno', then that item would appear in the second set along with 'páno' and 'səpáno'. Note that the target item 'spláno' has three initial consonants. The other two items in the set have two and one initial consonants respectively.

Six different random lists of the target words and six different random lists of test words (i.e., the target words and both variants) were constructed for testing. The lists were read aloud by one of the authors and recorded on an Ampex 300 tape deck. Listening tapes were then constructed from the master tape by re-recording on one channel of an Ampex 351-2 tape deck. Stimulus identification codes were recorded on the second channel of the magnetic tapes for computer presentation of the stimuli and for later recording of Ss' responses.

Equipment: The stimuli were presented automatically to Ss by means of a PDP-4 digital computer linked to an Ampex 351-2 tape recorder. The tape recordings were played to listeners through a loudspeaker at a comfortable listening level (approximately 75 db) in an audiometric room. All Ss were tested individually. The Ss' verbal responses were monitored by an intercom system and were tape recorded. Recognition responses were obtained by means of a response button mounted on a 4 x 4 metal utility box and were recorded and stored by the computer for later analyses.

Procedure: The S was comfortably seated in the audiometric room. Thereafter a tape recorded set of instructions was played (see Appendix B) which explained that the study was concerned with the way people are able to recognize artificial words. Ss were told that the experiment consisted of two parts: a listening part and a recognition part. In the listening part Ss were instructed to listen to each of the target words and then immediately repeat the word aloud. In the recognition part of the experiment Ss were presented with the list of "test words", which, as previously noted, consisted of the original target words mixed randomly with their two variants, a

total of 72 words. The Ss were instructed to press the response button whenever they heard a word in the test list which appeared in the target list they had just heard. Ss first listened and repeated the target words and then attempted to identify the target words within the test list.

The sequence of listening and repeating target words and then the recognition of the target words within the test list was repeated six times for each S. On every trial a different random order of target words was followed by a different random order of the test words.

Results

Identification responses to all of the test words were tabulated for each S. These responses were then apportioned into correct responses to target words and error responses to variants of target words. A correct identification response consisted of recognizing a target word from among the test words. Identification responses to variants were considered recognition errors. Separate tabulations for each target word and each variant were provided by the computer program. These scores were then analyzed across the 12 experimental conditions by an analysis of variance.

All scores are based on the data for 30 Ss. The percentages given are proportions obtained by dividing the mean raw scores by the total number of Ss.

Responses and Trials

Target words were identified significantly more frequently ($p < .001$) than either variant

Target	Variant I	Variant II
75.7	26.2	21.0

This significant difference allows for an analysis of the interactions of responses to target words and to variants.

Responses to target words increased with trials and responses to variants decreased with trials; i.e., Ss made fewer errors of identification throughout the course of the experiment (see Figure 1). Responses to both variants are combined.

Trial	1	2	3	4	5	6
Target	64.1	69.1	79.4	81.5	79.7	80.5
Variants	28.6	28.5	24.9	22.4	18.1	19.0

Insert Figure 1 about here

Responses to Cluster Position

Cluster position was significant ($p < .01$). Both correct and incorrect responses were most frequent for initial position, less frequent for medial position, and least frequent for final position (see Figure 2).

Position	Initial	Medial	Final
Target	80.7	76.2	70.0
Variants	27.6	22.2	21.1

Insert Figure 2 about here

Responses to Cluster Size

Cluster size was significant ($p < .01$). For target words 3 and 2 consonant clusters were identified more often than 1 or 0 consonants. On the other hand, for variants (errors), variants for target words with 3 and 1 consonants were chosen more frequently than variants for target words with 2 and 0 consonants (see Figure 3).

Cluster Size	3	2	1	0
Target	80.2	79.9	70.8	71.5
Variants	29.2	19.5	25.9	19.9

Insert Figure 3 about here

Discussion

That the position of consonants in the syllable has different effects for a hierarchy of syllable structure appears to be borne out. For correct identifications (target words) word initial position was strongest and word final position was weakest. The fact that medial consonants may bridge two syllables (i.e., may be the final consonants to a preceding vowel and the initial consonants to a following vowel) would explain their being identified more often than word final consonants but less often than word initial ones. However, for incorrect responses (variants) the same difference for positions in the syllable are found, except that the difference between medial and final position is not too significant, the important difference then being between initial and non-initial. Since Ss can respond to both a target word and one or both of its variants, correct responses to a target word could be negated by responses to a variant. A proportion obtained by dividing target responses by variant responses

reveals that there is most confusion for initial position and least for medial position.

Target/Variants	Initial	Medial	Final
	2.9	3.5	3.3

A similar problem arises for clusters. Although target words of 3 and 2 consonants are identified more often than those of 1 and 0 consonants, errors of identification are more frequent for 3 and 1 consonants than for 2 and 0 consonants. The proportion of target responses to variant responses reveals that clusters of 3 and 1 consonants are confused more often than 2 and 0 consonants.

Target/Variants	3	2	1	0
	2.8	4.0	2.7	3.6

If one assumes that the more preferred syllable structures would entail less confusions, then these preliminary results do not support the hierarchy found in the linguistic literature. However, we have by no means exhausted the analysis of the data and further analysis and tests may show dramatically different results from what is reported here. In particular, we would have to do a complete analysis for each target word and the particular variant it is confused with. This should be the next stage of our analysis and until such an analysis is completed the results reported here are merely tentative.

Footnotes

[1]The research reported herein was performed in part pursuant to Contract OEC-0-9-097740-3743 (014) with the U. S. Department of Health, Education, and Welfare, Office of Education, under the provisions of P.L. 83-531, Cooperative Research, and the provisions of Title VI, P.L. 85-864, as amended.

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Appendix A

Target and Variant Words

Target	Variant I	Variant II	Target	Variant I	Variant II
I3	I2	I1	F1	F2	F0
1 splano	spano	sᵊpano	13 sibok	sibosk	sibo
2 skrigə	krigə	səkigə	14 tæves	tævest	tæve
I2	I3	I1	F0	F1	F2
3 stefu	strefu	sətefu	15 zefi	zefis	zefist
4 pribo	spribo	pəribo	16 θulə	θuləp	θuləsp
I1	I2	I0	M3	M2	M1
5 pakes	spakes	akes	17 dækspu	dæksu	dækəsu
6 butɔp	brutɔp	utɔp	18 tikplə	tiplə	tipələ
I0	I2	I1	M2	M3	M1
7 ado	šrado	šado	19 boftan	bofstan	bofətan
8 obæf	klobæf	lobæf	20 tupko	tupkro	tupəko
F3	F2	F1	M1	M2	M0
9 sulinks	sulink	sulin	21 ginəpi	ginpi	giəpi
10 mifelps	mifeps	mifep	22 sibənə	sibnə	siənə
F2	F3	F1	M0	M1	M2
11 danəkt	danəkst	danək	23 vios	vilos	viglos
12 gisept	giseipt	giset	24 seak	sebak	sebrak

Appendix B

Instructions for Syllable Structure Experiment

Since this is a formal experiment it will be necessary to have your close attention. First of all will you please state your full name, age and sex. This information is important so that we don't call you again for the same experiment. Okay, fine.

The present study deals with the manner in which people recognize artificial words. More specifically you will be presented with two lists of artificial words. The first list we call "target words" and the second list we will call "test words." Your task today is composed of two parts. In part one your task consists of listening to each of the target words and then immediately repeating it aloud before the next word appears. Since there is sufficient time between each target word on the list you should have no difficulty immediately repeating the word you just heard. Prior to the onset of the target words you will hear one tone. This tone signals the beginning of the target lists. At the end of the target list of words you will hear one

tone. This tone signals the end of the target list. In part two of the experiment you will hear another list of artificial words, the test words. Some of the words in this list previously occurred in the target list and some of the words are new. Your task in part two is to listen to each of the words and then press the button in front of you when you think the word you just heard previously appeared in the target list. It is very important that you listen carefully to the whole word before you make your response since many of the words in the "test list" sound quite similar to the words in the "target list." Since time is important in this recognition task be sure to respond as quickly as possible. Prior to the onset of the test words you will hear two tones. These two tones signal the beginning of the test list. After completion of part two you will hear another two tones--this will signal the end of the test list. This procedure, for example, part one, listening to "target words" and then repeating them aloud, and then part two, the recognition of the "test words", will be repeated several times. Okay, are there any questions about the nature of the tasks you are going to perform???

Just to be sure that you understand the exact nature of both of these tasks I will repeat the instructions again. Your task today is composed of two parts. In part one your task consists of listening to each of the target words and then immediately repeating it aloud before the next word appears. Since there is sufficient time between target words on the list you should have no difficulty immediately repeating the word you just heard. Prior to the onset of the target words you will hear one tone. This tone signals the beginning of the target list. At the end of the target list of words you will hear one tone. This tone signals the end of the target list. In part two of the experiment you will hear another list of artificial words, the test words. Some of the words in this list previously occurred in the target list and some of the words are new. Your task in part two is to listen to each of the words and then press the button in front of you when you think the word you just heard previously appeared in the target list. It is very important that you listen carefully to the whole word before you make your response since many of the words in the "test list" sound quite similar to the words in the "target list." Since time is important in this recognition task be sure to respond as quickly as possible. Prior to the onset of the test words you will hear two tones. These two tones signal the beginning of the test list. After completion of part two you will hear another two tones--this will signal the end of the test list. This procedure, for example, part one, listening to "target words" and then repeating them aloud, and then part two, the recognition of the "test words" will be repeated several times. Okay, we will now begin the experiment.

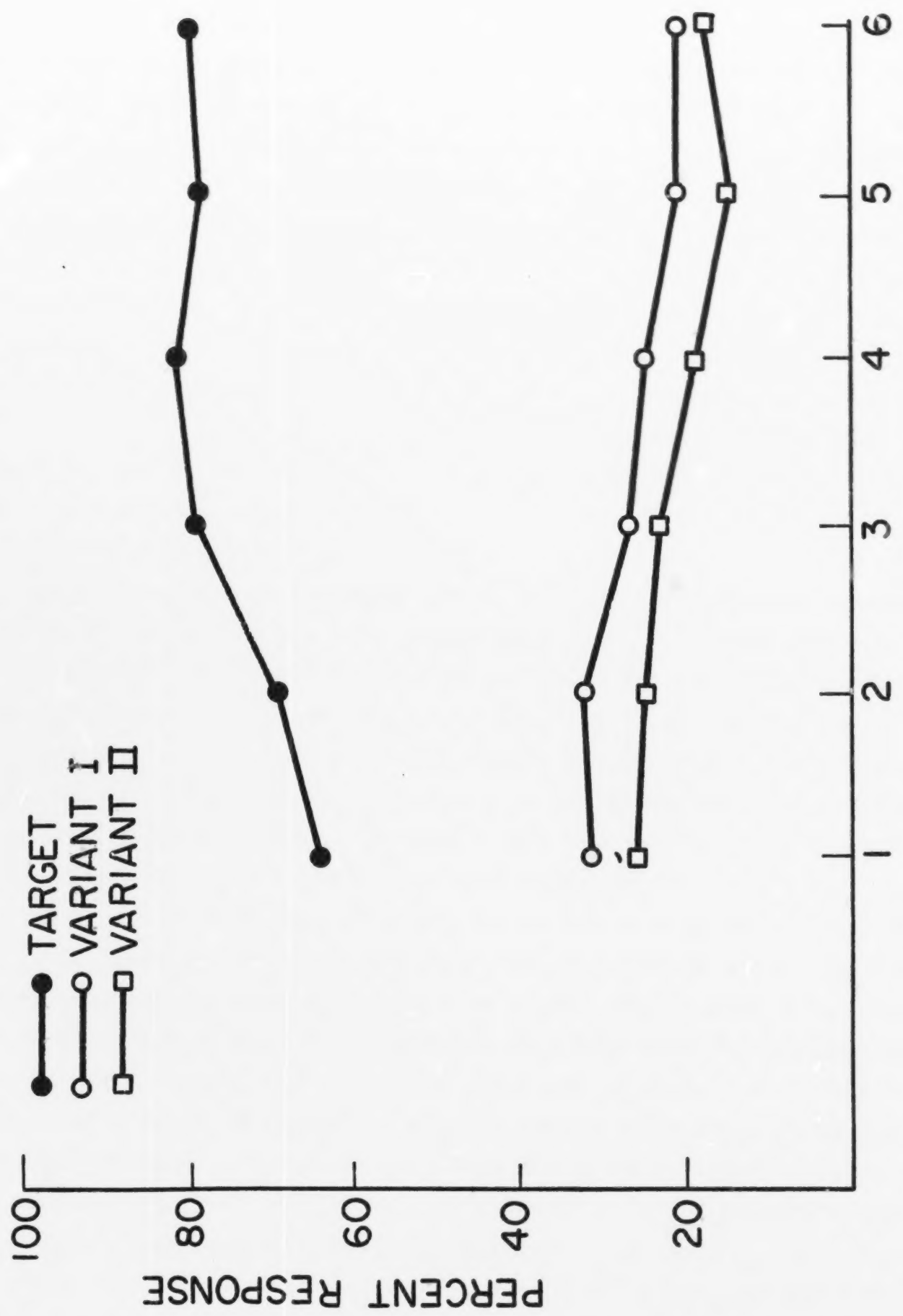
PERCENT RESPONSE
100
80
60
40
20
TARGET
VARIANT I
VARIANT II
1
2
3
4
5
6
TRIALS

Figure 1

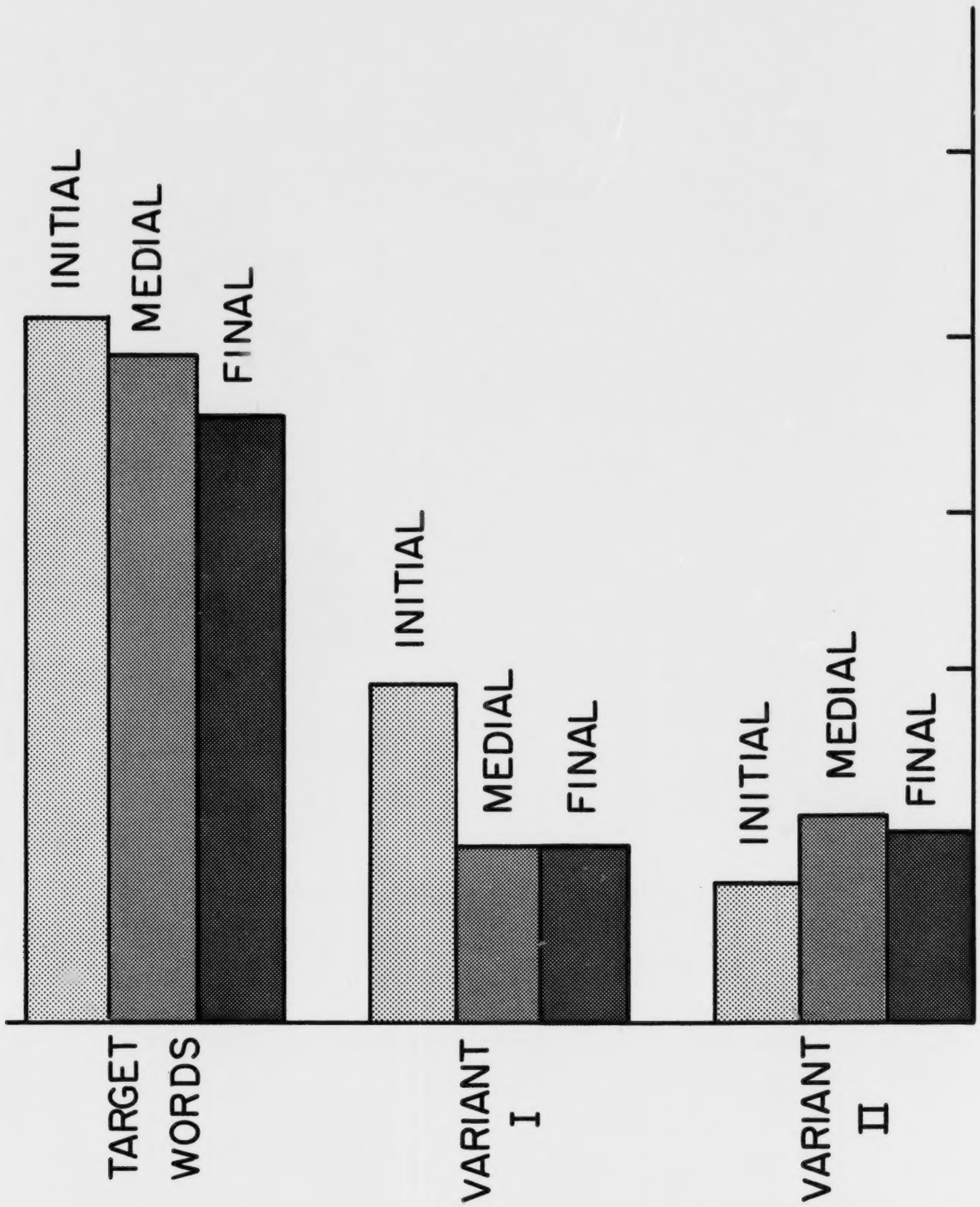
TARGET WORDS
INITIAL
MEDIAL
FINAL
VARIANT I
INITIAL
MEDIAL
FINAL
VARIANT II
INITIAL
MEDIAL
FINAL
20
40
60
80
100
PERCENT RESPONSE

Figure 2

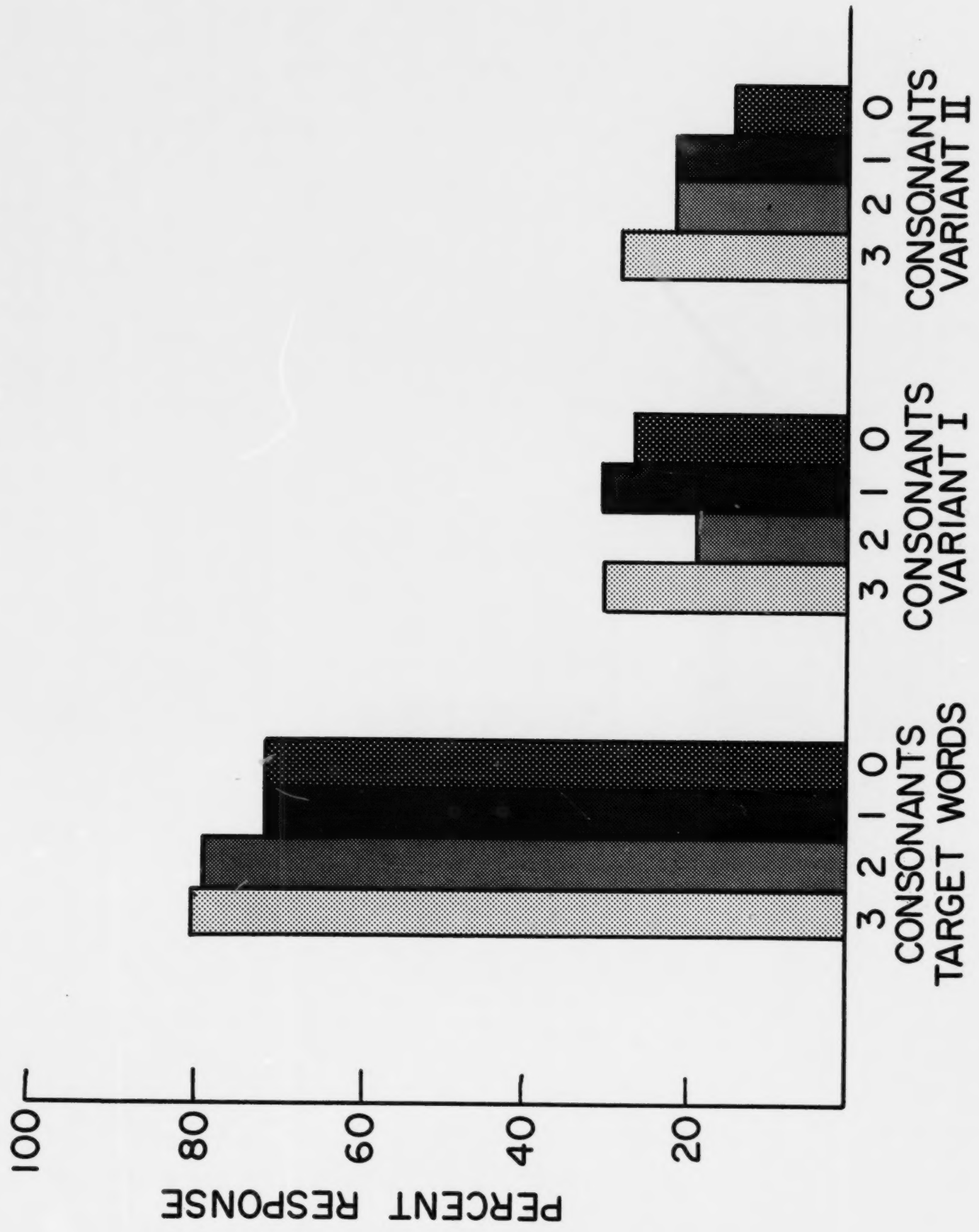
PERCENT RESPONSE
100
80
60
40
20
3 2 1 0
CONSONANTS
TARGET WORDS
3 2 1 0
CONSONANTS
VARIANT I
3 2 1 0
CONSONANTS
VARIANT II

Figure 3